REMARKS

Status of Claims

Claims 1 – 36 were original in the application. Claims 2 – 10, 14 – 24, 26, and 32 have been cancelled. Claims 1, 11, 13, 25, 30, 31, and 36 have currently been amended. Claims 1, 11 - 13, 25, 27 – 31, and 33 – 36 are submitted for examination on the merits.

Rejection Pursuant to 35 USC 112

Claims 1 and 11 - 13 were rejected as based on a disclosure which is not enabling. The Examiner contended that the steps of cryomilling a NiCrAlY powder and thermally spraying the cryomilled powder appear to be critical or essential to the practice of the invention, but are not included in the claim(s) and are not enabled by the disclosure. The Examiner contended that to achieve the nanocrystalline, nano-composite bond coat, the step of cryomilling and thermally spraying the NiCrAlY bond coat appears to be essential in forming the article, and as such, this limitation should be in the independent claims.

Claim 1, for example, includes the step of "providing a nanocrystalline, nano-composite bond coat on the substrate". The Examiner contends that the step of "providing" such a coat must be subdivided into two more specifically defined steps, namely cryomilling and thermally spraying. Claim 2 call for a thermal spray in the step of "providing". Claim 4 which depends on claim 2 calls for a step of cryomilling as part of the step of "providing".

Claim 13 is a structural composition of matter claims to which contentions of method step limitations are irrelevant to patentability.

Turn first to the apparent contention of lack of enabling disclosure. Cryomilling and thermally spraying are steps repeatedly disclosed throughout the specification with abundant detail. The composition of the bond coat is more generally disclosed than stated by the Examiner. For example, paragraph [0018] discloses:

> [0018] In the illustrated embodiment the nanostructured, nano-composite bond coat is composed of nanocrystalline **MCrAlY, where M stands for either Co, Ni and/or Fe**, prepared using a high velocity oxy fuel (HVOF) or low pressure plasma spray (LPPS) thermal spray process onto a metallic substrate. The ceramic top coat on the nanostructured bond coat comprises a yttria partially stabilized zirconia (YPSZ) ceramic top coat. (emphasis added)

Thus, there is no argument that a step of providing a nanocrystalline, nano-composite bond coat (of NiCrAlY as one example) on the substrate is clearly, adequately and without question enabled. The fact that the illustrated embodiment discloses this step of providing the bond coat by a combination of steps of cryomilling and thermal spraying does not render the step of providing the bond coat nonenabled.

It is improper to reject a general claim definition which is enabled only because it is not particularized to the illustrated embodiment. It is a well recognized maxim of claim construction under patent law that the claims may be more broadly defined than the disclosed or illustrated embodiment. *Superguide Corp. v. DirecTV Enterprises, Inc.*[1] as cited at MPEP 2111.01 states:

> "Though understanding the claim language may be aided by explanations contained in the written description, it is important not to import into a claim limitations that are not part of the claim. For example, a particular embodiment

[1] *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875, 69 USPQ2d 1865, 1868 (Fed. Cir. 2004)

> appearing in the written description may not be read into a claim when the claim language is broader than the embodiment."

Claims are not rejected as broader than the enabling disclosure under 35 U.S.C. 112 for noninclusion of limitations dealing with factors which must be presumed to be within the level of ordinary skill in the art; the claims need not recite such factors where one of ordinary skill in the art to whom the specification and claims are directed would consider them obvious.[2] Cryomilling and thermal spraying are well known steps used in coating methods. *Raytheon Co. v. Roper Corp.*[3] as cited at MPEP 2164.08 states:

> "That claims are interpreted in light of the specification does not mean that everything in the specification must be read into the claims."

Further, paragraph [0093] states:

> [0093] . . . Therefore, it must be understood that the illustrated embodiment has been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following claims. . . .

Claims 11, 30, 31, and 36 were rejected under section 112, second paragraph and have been responsively amended.

The Examiner questioned claim 31 asking whether the MCrAlY bond coat is the same as the nanostructured nanocomposite bond coat. Claim 31 is directed to a MCrAlY thermal barrier coating comprised of a MCrAlY bond coat on a substrate and a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains. Claim 31 corresponds to method claim 25. These claims refer to a system in which a

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[2] *In re Skrivan*, 427 F.2d 801, 806, 166 USPQ 85, 88 (CCPA 1970). See MPEP 21064.08

[3] *Raytheon Co. v. Roper Corp.*, 724 F.2d 951, 957, 220 USPQ 592, 597 (Fed. Cir. 1983), *cert. denied,* 469 U.S. 835 (1984)

conventional MCrAlY bond coat on a substrate is then in turn coated with a nanostructured nano-composite bond coat with nanocrystalline size MCrAlY grains.

The Examiner questioned claims 30 and 36 asking where the steps of refining "after" cryomilling and introducing alumina "during" cryomilling are performed. Claims 30 and 36 are directed to the limitation where the step of refining the microstructure of the MCrAlY powder to nanocrystalline grain size after cryomilling comprises the step of introducing nano alumina whiskers during cryomilling. The microstructure of the MCrAlY powder is not refined to nanocrystalline grain size before cryomilling, although by the time cryomilling is completed it is. This step is accomplished in these claims by introducing nano alumina whiskers during the time when this cryomilling takes place.

Claim Rejections - 35 USC § 102

Claims 1, 13, 25 - 27, and 31 - 33 were rejected as being anticipated by Hebsur US Patent 6,805,725. The Examiner cited Hebsur '725 as teaching a bond coat comprising NiAl and CoCrAlY which is cryomilled in nitrogen, and plasma sprayed onto a substrate. The Examiner contended that:

> a ceramic top coat is formed over the bond coat; during cryomilling, AlN particles are formed in the bond coat and have a particle size of 10-50 nanometers; and
>
> the bond coat is formed via a method that is commensurate with that of the applicant's disclosure;

therefore the Examiner argues that the manufactured article is expected to share similar characteristics.

Hebsur '725 discusses the beneficial effects resulting from a bond coat that consists of a NiAl-CoCrAlY matrix reinforced with dispersed fine-grained (nano size) AlN particles introduced by cryomilling. Hebsur '725 asserts that this bond coat (AlNi-CoCrAlY plus AlN dispersed particles) exhibits superior thermal-mechanical fatigue properties, which results from enhanced oxidation and creep resistances, improved CTE mismatch, increased modulus, when compared to the conventional MCrAlY-type bond coats.

Note, however, that only the AlN particles are disclosed as nano sized and that the matrix, which is never disclosed as nanostructured, is only stated as being reinforced by the AlN particles. This rather strongly implies that the matrix itself has no characterizing nanostructure. Hebsur '725 used cryomilling to prepare the powder feedstock for the NiAl-CoCrAlY-AlN (nano size particles) bond coat, but fails to disclose that the bond coat is nanocrystalline. In fact at the high speeds, 800rpm, that Hebsur is cryomilling, there is considerable doubt whether the matrix is nanocrystalline at all. Hebsur '725 significantly discloses only that the AlN particles formed in situ is nanocrystalline and makes no such disclosure about the NiAl—CoCrAlY matrix itself which forms the bulk of the material. Also significantly the teaching of Hebsur '654 is cumulative on this point. This should not be read into the Hebsur '725 disclosure.

A second point should also be clearly understood. There are two alloy systems which represent the current state of the art with respect to metal coatings, one is the NiAl system and the other is the MCrAlY system. Each alloy system is well worked out, tested and separately accepted in the field of metallurgy for exhibiting certain properties. Hebsur '725 combines these two different alloy systems. It is very clear that Hebsur

'725 requires a NiAl component with CoCrAlY where the NiAl component comprises 85 to 70 percent by volume of the alloy. Hebsur '725 obtains his result only by relying on a very much more complex alloy system with substantial amounts of NiAl. Even more importantly, Hebsur '725's system is predominantly a NiAl system with minority amounts of CoCrAlY as an additive.

Distinct in the art from a NiAl system what is being claimed in this case is essentially an improved MCrAlY system in which a fully nanocrystalline matrix is provided with or without alumina additives introduced into the cryomilling process. There is no expectation, teachings or leadings from the NiAl system of Hebsur '725 that the characteristics or benefits realized in the improved MCrAlY system of the claimed invention could be obtained.

In contrast with the claimed invention we have seem dramatic improvement in the thermal cycling lifetimes of TBCs by simply cryomilling MCrAlY conventional powders for our bond coats without any additive. Claims 1, 13 and 25 as amended employ a bond coat composed substantially only of nanocrystalline MCrAlY, where M stands for either Co, Ni and/or Fe, using a thermal spray process onto a metallic substrate. New claims 37 – 45 require the bond coat to be fully nanocrystalline and not only an in situ alumina. For these reasons alone, it cannot be maintained that Hebsur '725 discloses each and every limitation of the amended or added claims.

The Examiner is also requested to particularly turn to claim 25 where a method for improving a MCrAlY thermal barrier coating made from MCrAlY powder, where M is a metal or metal alloy is claimed. Here a conventional MCrAlY bond coat is provided on the substrate. A nanocrystalline or nanostructured nano-composite coating is then

provided on the conventional MCrAlY bond coat by refining the microstructure of the MCrAlY powder to nanocrystalline grain size. Nowhere in Hebsur '725 is there any disclosure for refining a conventional MCrAlY bond coat simply by only refining the microstructure of the MCrAlY powder to nanocrystalline grain size.

Newly added claim 41 is further distinguished from Hebsur '725 by requiring a fully nanocrystalline MCrAlY bond coat on the substrate composed of more than 30% by volume of the coating.

Newly added claim 43 is further distinguished from Hebsur '725 by requiring a fully nanocrystalline MCrAlY bond coat combined with an Al_2O_3 nanoparticle additive disposed throughout the fully nanocrystalline MCrAlY bond coat which Al_2O_3 nanoparticle additive was added during cryomilling of the MCrAlY powder. As per claims 44 and 45 the cryomilling is done a low speed below 450rpm as opposed to the 800rpm speeds disclosed by Hebsur '725 through the disclosed use of a Union Process model 1-S attritor, which is well known in the art as a low speed cryomill.

Rejection Pursuant to 35 USC 103(a)

Claims 11, 12, 28, 29, 34, and 35 were rejected as obvious over Hebsur '725 in view of Hebsur '654. Hebsur '725 was cited as teaching a bond coating formed via cryomilling as discussed above, but without teaching the formation of aluminum oxide during cryomilling. Hebsur '654 was cited as teaching a bond coating similar to that of Hebsur '725, and further as teaching that depending on the material system being used, cryomilling can be reacted with nitrogen or oxygen. As discussed in both patents, nitrogen forms AlN particles in the bond coating, and Hebsur '654 teaches that oxygen

forms alumina on the powder particles. As Hebsur '654 teaches that NiAl may be cryomilled with oxygen or nitrogen depending upon the material system being used, it would have been obvious that the bond coating of Hebsur '725 could also be cryomilled with oxygen.

Claims 11 and 12 are directed to a step of providing a nanocrystalline alumina coating by cryomilling an alumina powder to achieve nanocrystalline grain sizes and disposing the cryomilled nanostructured alumina composite coating on a bond coat on the substrate. Nothing in Hebsur '525 and '654 is related to nanocoating bond coats.

Claims 28, 29, 34 and 35 are directed to a step of providing refining the microstructure of the MCrAlY powder to nanocrystalline grain size during cryomilling comprises introducing or adding nano alumina particles during cryomilling. This is an additive and is not formed in situ. Nothing in Hebsur '525 and '654 is related to nanoseeding MCrAlY powder during cryomilling with an alumina additive.

Applicant respectfully requests advancement of the claims to allowance.

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